

# Exhibit 8

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Title:** 3D POINTING DEVICE AND METHOD FOR COMPENSATING  
ROTATIONS OF THE 3D POINTING DEVICE THEREOF

Appl. No.	:	13/176,771	Confirmation No.	5154
Applicant	:	Zhou Ye et al.		
Filing Date	:	07/06/2011		
TC/A.U.	:	2692		
Examiner	:	SADIO, INSA		
Docket No.	:	040-13-0052.IUS		
Customer No.		66749		

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

**Amendments**

In response to the outstanding Office action, mailed on Jan. 28, 2013, in connection with the above-identified application, kindly amend the subject application as follows and consider the accompanying remarks.

**Amendments to the Claims** are reflected in the listing of claims, which begins on page **2** of this paper.

**Remarks** begin on page **9** of this paper.

### **Amendments to the Claims**

This listing of claims will replace all prior versions, and listings, of claims in the application:

#### **Listing of Claims:**

1. (currently-amended) A 3D pointing device, comprising:

an orientation sensor, generating an orientation output associated with an orientation of the 3D pointing device associated with three coordinate axes of a global reference frame associated with Earth;

a rotation sensor, generating a rotation output associated with a rotation of the 3D pointing device associated with three coordinate axes of a spatial reference frame associated with the 3D pointing device; and

a first computing processor, using the orientation output and the rotation output to generate a transformed output associated with a fixed reference frame associated with a display device[. ],\_\_

wherein the orientation sensor comprises:

an accelerometer, generating a first signal set comprising axial accelerations associated with movements and rotations of the 3D pointing device in the spatial reference frame;

a magnetometer, generating a second signal set associated with Earth's magnetism; and

a second computing processor, generating the orientation output based on the first signal set, the second signal set and the rotation output or based on the first signal set and the second signal set;

wherein the rotation sensor, the accelerometer, and the magnetometer forming a nine-axis motion sensor module; the 3D pointing device is configured for obtaining one or more resultant deviation including a plurality of deviation angles using a plurality of measured magnetisms  $M_x$ ,  $M_y$ ,  $M_z$  and a plurality of predicted magnetism  $M_x'$ ,  $M_y'$  and  $M_z'$ .

2. (canceled)

3. (canceled)

4. (currently-amended) The 3D pointing device of claim ~~[[3]]~~1, wherein the orientation output comprises a yaw angle, a pitch angle, and a roll angle associated with the three coordinate axes of the global reference frame; the first signal set comprises a first axial acceleration, a second axial acceleration, and a third axial acceleration; the second computing processor calculates the pitch angle based on the first axial acceleration, calculates the roll angle based on the second axial acceleration and the pitch angle or based on the third axial acceleration and the pitch angle, and calculates the yaw angle based on the pitch angle, the roll angle, and the second signal set.

5. (original) The 3D pointing device of claim 1, wherein the orientation output provided by the orientation sensor is a rotation matrix, a quaternion, a rotation vector, or comprises three orientation angles.

6. (original) The 3D pointing device of claim 1, wherein the transformed output represents a segment of a movement in a plane in the fixed reference frame

parallel to a screen of the display device.

7. (original) The 3D pointing device of claim 1, wherein the first computing processor obtains an orientation of the display device associated with the global reference frame, obtains an orientation of the 3D pointing device associated with the fixed reference frame based on the orientation output and the orientation of the display device associated with the global reference frame, generates a transformed rotation associated with the fixed reference frame based on the orientation of the 3D pointing device associated with the fixed reference frame and the rotation output, and generates the transformed output based on the transformed rotation.

8. (original) The 3D pointing device of claim 7, wherein when the first computing processor receives a reset signal, the first computing processor records a current orientation output generated by the orientation sensor as the orientation of the display device associated with the global reference frame.

9. (original) The 3D pointing device of claim 8, wherein the current orientation output comprises a yaw angle associated with one of the three coordinate axes of the global reference frame, the first computing processor obtains the orientation of the 3D pointing device associated with the fixed reference frame by subtracting the yaw angle from the orientation output.

10. (original) The 3D pointing device of claim 7, wherein the first computing processor obtains a rotation matrix from the orientation of the 3D pointing device associated with the fixed reference frame, and multiplies the rotation

matrix and the rotation output together to generate the transformed rotation.

11. (original) The 3D pointing device of claim 10, wherein the transformed rotation comprises a first angular velocity, a second angular velocity, and a third angular velocity associated with three coordinate axes of the fixed reference frame; the transformed output comprises a first movement component and a second movement component associated with two of the three coordinate axes of the fixed reference frame; the first computing processor multiplies the second angular velocity by a scale factor to generate the second movement component and multiplies the third angular velocity by the scale factor to generate the first movement component.

12. (currently-amended) A method for compensating rotations of a 3D pointing device, comprising:

generating an orientation output associated with an orientation of the 3D pointing device associated with three coordinate axes of a global reference frame associated with Earth;

generating a first signal set comprising axial accelerations associated with movements and rotations of the 3D pointing device in the spatial reference frame;

generating a second signal set associated with Earth's magnetism;  
generating the orientation output based on the first signal set, the second signal set and the rotation output or based on the first signal set and the second signal set;

generating a rotation output associated with a rotation of the 3D pointing device associated with three coordinate axes of a spatial reference frame associated with the 3D pointing device; and

using the orientation output and the rotation output to generate a transformed output associated with a fixed reference frame associated with a display device[[.]], wherein the orientation output and the rotation output is generated by a nine-axis motion sensor module; obtaining one or more resultant deviation including a plurality of deviation angles using a plurality of measured magnetisms  $M_x$ ,  $M_y$ ,  $M_z$  and a plurality of predicted magnetism  $M_x'$ ,  $M_y'$  and  $M_z'$  for the second signal set.

13. (canceled)

14. (canceled)

15. (currently amended) The method of claim [[14]]12, wherein the orientation output comprises a yaw angle, a pitch angle, and a roll angle associated with the three coordinate axes of the global reference frame; the first signal set comprises a first axial acceleration, a second axial acceleration, and a third axial acceleration; the step of generating the orientation output based on the first signal set and the second signal set comprises:

calculating the pitch angle based on the first axial acceleration;

calculating the roll angle based on the second axial acceleration and the pitch angle or based on the third axial acceleration and the pitch angle; and

calculating the yaw angle based on the pitch angle, the roll angle, and the second signal set.

16. (original) The method of claim 12, wherein the orientation output is a rotation matrix, a quaternion, a rotation vector, or comprises three orientation angles.

17. (original) The method of claim 12, wherein the transformed output represents a segment of a movement in a plane in the fixed reference frame parallel to a screen of the display device.

18. (original) The method of claim 12, wherein the step of generating the transformed output comprises:

- obtaining an orientation of the display device associated with the global reference frame;

- obtaining an orientation of the 3D pointing device associated with the fixed reference frame based on the orientation output and the orientation of the display device associated with the global reference frame;

- generating a transformed rotation associated with the fixed reference frame based on the orientation of the 3D pointing device associated with the fixed reference frame and the rotation output; and

- generating the transformed output based on the transformed rotation.

19. (original) The method of claim 18, wherein the step of obtaining the orientation of the display device associated with the global reference frame comprises:

- recording a current orientation output as the orientation of the display device associated with the global reference frame in response to a reset signal.

20. (original) The method of claim 19, wherein the current orientation output comprises a yaw angle associated with one of the three coordinate axes of the global reference frame, and the step of obtaining the orientation of the 3D pointing device associated with the fixed reference frame comprises: obtaining the orientation of the 3D pointing device associated with the fixed reference frame by subtracting the yaw angle from the orientation output.

21. (original) The method of claim 18, wherein the step of generating the transformed rotation comprises:

- obtaining a rotation matrix from the orientation of the 3D pointing device associated with the fixed reference frame; and

- multiplying the rotation matrix and the rotation output together to generate the transformed rotation.

22. (original) The method of claim 21, wherein the transformed rotation comprises a first angular velocity, a second angular velocity, and a third angular velocity associated with three coordinate axes of the fixed reference frame; the transformed output comprises a first movement component and a second movement component associated with two of the three coordinate axes of the fixed reference frame; the step of generating the transformed output based on the transformed rotation comprises:

- multiplying the second angular velocity by a scale factor to generate the second movement component; and

- multiplying the third angular velocity by the scale factor to generate the first movement component.

## REMARKS

Applicant has amended claims 1, 4, 12 and 15, and cancelled claims 2, 3, 13, and 14 without prejudice. The amendments to the claims are based on what was previously expressly disclosed or inherent in the specification as originally filed. No new matter is added. Applicant respectfully submits that all the hitherto pending claims are now placed in position for allowance. Detailed reasons for allowance are provided below.

### ***Double Patenting Rejections under 37 CFR 1.78(b)***

Claims 1-22 of this application conflict with claims 1-20 of Application No. 12/943,034. Applicant is required to either cancel the conflicting claims from all but one application or maintain a clear line of demarcation between the applications.

In response, Applicant submits that claim 1 is hereby amended to include new limitations of “a nine-axis motion sensor module” and “the 3D pointing device is configured for obtaining one or more resultant deviation including a plurality of deviation angles using a plurality of **measured magnetisms** Mx, My, Mz and a plurality of **predicted magnetism** Mx', My' and Mz'”, and claim 12 is hereby amended to include new limitations of “wherein the orientation output and the rotation output is generated by a nine-axis motion sensor module” and “obtaining one or more resultant deviation including a plurality of deviation angles using a plurality of measured magnetisms Mx, My, Mz and a plurality of predicted magnetism Mx', My' and Mz' for the second signal set” to fully patentably differentiate and provide clear line of demarcation between this application and Application No. 12/943,034.

Applicant submits that Application No. 12/943,034 includes the claimed subject matter of a six-axis motion sensor module without having and using measured magnetisms and predicted magnetisms.

Based on the amendments to claims 1 and 12, Applicant submits that the double patenting rejections are overcome.

***Claim Rejections under 35 U.S.C. §103***

Claims 1-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nasiri et al. (20090262074), hereinafter referred to as Nasiri.

**In response, regarding claim 1,**

Applicant submits that [0059] and [0071] of the specification of instant application expressly recites features regarding the motion sensor module's magnetometer signals used to facilitate the obtaining of the resultant deviation including deviation angles in 3D reference, in which measured magnetisms  $M_x$ ,  $M_y$ ,  $M_z$  are obtained, and predicted magnetism  $M_x'$ ,  $M_y'$  and  $M_z'$  are calculated and obtained.

Applicant submits the limitations of amended claim 1 which includes of (1) wherein the rotation sensor, the accelerometer, and the magnetometer forming a nine-axis motion sensor module; and (2) obtaining resultant deviation including deviation angles using a plurality of measured magnetisms  $M_x$ ,  $M_y$ ,  $M_z$ , and a plurality of predicted magnetism  $M_x'$ ,  $M_y'$  and  $M_z'$  are patentable over Nasiri based on the following traversal.

Regarding amended claim 1, Applicant submits that Nasiri fails to teach or

suggest of having orientation associated or **defined with respect to the global reference frame**. Referring to [0145] of Nasiri, which recites “In one embodiment, the gyroscopes and accelerometers can be combined in a sensor fusion algorithm in order to provide a rotation matrix, quaternion, or Euler angle representation of the devices orientation in space. This orientation can be mapped directly or with constraints to a **virtual world** shown in the display of the device.” And to [0123] of Naziri, which recites that “ In the present invention, a yaw gyroscope can be used to control portrait and landscape orientation in this case or horizontal screen orientation.” Therefore, the orientation taught in Nasiri **is with respect to spatial reference frame, and therefore fails to be “associated with three coordinate axes of a global reference frame** associated with Earth” as claimed in claim 1.

Applicant submits the claimed invention for amended claim 1 for the 3D pointing device adopts a nine-axis motion sensor module with an **enhanced comparison** method or model for **eliminating accumulated errors** of said nine-axis motion sensor module to obtain **deviation angles** corresponding to movements and rotations of said electronic device in a spatial pointer reference frame. In other words, the claimed invention for amended claim 1 for the 3D pointing device of the present invention is capable of accurately outputting the deviation angles including yaw, pitch and roll angles in a 3D spatial pointer reference frame of the 3D pointing device to eliminate or reduce accumulated errors and noises generated over time in a dynamic environment.

Comparing to the specification of present application in [0013], which is reproduced as follow: “[0013] According to another example embodiment of

the present invention, an electronic device capable of generating 3D deviation angles and for use in for example computers, motion detection or navigation is provided. The electronic device may utilize a nine-axis motion sensor module with an **enhanced comparison** method or model for **eliminating accumulated errors** of said nine-axis motion sensor module to obtain **deviation angles** corresponding to movements and rotations of said electronic device in a spatial pointer reference frame. The comparison method or model may be advantageously provided by comparing signals from the abovementioned nine-axis motion sensor module capable of detecting rotation rates or angular velocities of the electronic device about all of the  $X_P$ ,  $Y_P$  and  $Z_P$  axes as well as axial accelerations and ambient magnetism including such as earth's magnetic field or that of other planets of the electronic device along all of the  $X_P$ ,  $Y_P$  and  $Z_P$  axes such that **deviation angles of the resultant deviation** of the electronic device of the present invention may be preferably obtained or outputted **in an absolute manner**. In other words, the present invention is capable of accurately outputting the abovementioned deviation angles including yaw, pitch and roll angles in a 3D spatial pointer reference frame of the 3D pointing device to eliminate or reduce accumulated errors and noises generated over time in a dynamic environment including conditions such as being subject to a combination of continuous movements, rotations, external gravity forces, magnetic field and additional extra accelerations in multiple directions or movement and rotations that are continuously nonlinear with respect to time; and furthermore, based on the deviation angles being compensated and accurately outputted in 3D spatial reference frame may be further mapped onto or translated into another reference frame such as the abovementioned display frame, for example a reference in two-dimension

(2D).” (emphasis added), Applicant submits that Nasiri teaches the following in [0068]: “Having other algorithms that filter out hand shake and reduce drift may also be used to improve the usability of the device.” and Nasiri teaches the following in [0049]: “Some implementations may employ more than three gyroscopes, for example to enhance accuracy, increase performance, or improve reliability. Some implementations may employed more than three accelerometers, for example to enhance accuracy, increase performance, or improve reliability”.

Based on the above teachings from Naziri, it can be deduced that Naziri teaches away from the above **enhanced comparison** method for **eliminating accumulated errors** of nine-axis motion sensor module to obtain **deviation angles** corresponding to movements and rotations of said electronic device in a spatial pointer reference frame, **by teaching instead**, on using algorithms for filtering out hand shake, and using more than 3 gyroscopes and/or more than 3 accelerometers for improving accuracy and performance.

Applicant further submits that, Nasiri **only briefly** describes about “magnetometers” in [0053] and [0067], as being reproduced below as follows:

[0053]: “For example, sensors such one or more barometers, compasses or magnetometers, temperature sensors, optical sensors (such as a camera sensor, infrared sensor, etc.), ultrasonic sensors, radio frequency sensors, or other types of sensors can be provided. For example, a compass or **magnetometer sensor can provide an additional one, two, or three axes of sensing, such as two horizontal vectors and a third vertical**

**vector.**" (emphasis added)

[0067]: "These control signals may be derived only from gyroscopes of the device, or they may be derived from a combination of any of gyroscopes, accelerometers, and magnetometers of the device as the output of a sensor fusion algorithm (e.g., an algorithm combining inputs from multiple sensors to provide more robust sensing, an example of which is described in copending U.S. patent application Ser. No. 12/252,322, incorporated herein by reference)."

Based on the above reproduced passages from Nasiri, it can deduced that Nasiri fails to disclose or teach of **calculating resultant deviations based upon axial accelerations and magnetisms** as claimed in amended claim 1.

Applicant submits that Nasiri fails to disclose or teach of **a nine-axis motion sensor module**, but instead, Nasiri teaches a 6-axis sensing device being provided for providing sensing in six degrees of freedom, and teaching also the following: In embodiments with more than three gyroscopes and/or more than three accelerometers, additional degrees of freedom (or sensing axes) can be provided, and/or additional sensor input can be provided for each of the six axis of motion.

Regarding claim 12, claim 12 is amended to include the similar or substantially the same patentable limitations that have been discussed above under amended claim 1, therefore, amended claim 12 should also be patentable and allowable over Nasiri based on the same reasons as that of

claim 1.

### **Conclusion**

Applicant submits that the amendments made herein to claims 1 and 12 are sufficient for overcoming rejections under 35 U.S.C. 103(a) as being unpatentable over Nasiri.

Since dependent claims 4-11 depend on claim 1, and dependent claims 15-22 depend on claim 12, upon allowance of independent claims 1 and 12, dependent claims 4-11 and dependent claims 15-22 should also be patentable and allowable over Nasiri, respectively.

Therefore, Applicant respectfully requests that a timely Notice of Allowance be issued for the instant application.

Respectfully yours,

          /Ding Yu Tan/          

Ding Yu Tan, Reg. # 58812

Tel 281-668-8988

Date: April 17, 2013